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U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 42.

B. T. GALLOWAY, *Chief of Bureau.*

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THREE NEW PLANT INTRODUCTIONS FROM JAPAN.

BY

DAVID G. FAIRCHILD, AGRICULTURAL EXPLORER.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

ISSUED JUNE 24, 1903.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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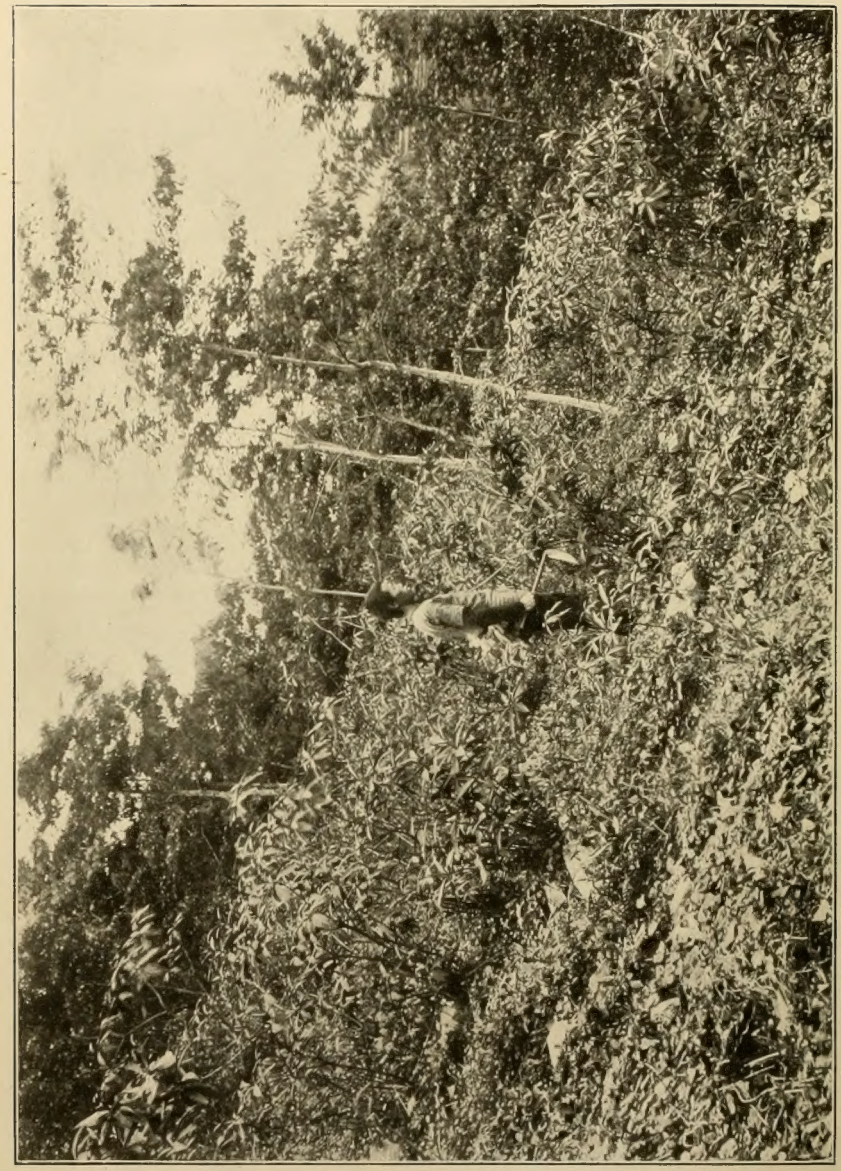

A HILLSIDE COVERED WITH MITSUMATA, THE JAPANESE PAPER PLANT.

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BUREAU OF PLANT INDUSTRY.

BEVERLY T. GALLOWAY, *Chief of Bureau.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

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By transfer
MAR 31 1908

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., May 13, 1903.

Sir: I have the honor to transmit herewith a paper entitled "Three New Plant Introductions from Japan," and respectfully recommend that it be published as Bulletin No. 42 of this Bureau.

This paper was prepared by Mr. D. G. Fairchild, Agricultural Explorer, who has been detailed by you to accompany Mr. Barbour Lathrop on his expeditions in search of valuable seeds and plants, and it has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution, with a view to publication.

The six full-page half-tone illustrations are an essential part of the paper.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

As a result of his observations on the agriculture of Japan, Mr. D. G. Fairchild has contributed several papers designed to interest American cultivators in new crops. Three of these papers are published in this Bulletin. One on a Japanese paper plant calls the attention of farmers in the mild and humid regions of the United States to a possible new industry, while those on the udo and on the Japanese horse-radish will doubtless prove of interest both to market gardeners and amateurs who take pleasure in cultivating the best vegetables.

The plants and seeds received from Mr. Lathrop, through Mr. Fairchild, have been placed for trial with reliable horticulturists, and the results of these tests will enable us in the course of time to report more fully regarding the adaptability of these plants to our conditions.

A. J. PIETERS,
Botanist in Charge.

OFFICE OF BOTANIST IN CHARGE OF SEED
AND PLANT INTRODUCTION AND DISTRIBUTION,
Washington, D. C., May 8, 1903.

CONTENTS.

	Page.
Mitsumata, a Japanese paper plant.	
Introduction	9
Species of paper plants in Japan	11
The mitsumata plant	11
The cultivation of mitsumata	12
The manufacture of mitsumata paper	14
The manufacture of leather paper	15
Udo, a new winter salad.	
Introduction	17
The cultivation of kan udo	18
The cultivation of moyashi udo	19
Wasabi, the horse-radish of the Japanese.	
Introduction	20
The cultivation of wasabi	21
Description of plates	24

ILLUSTRATIONS.

Page.

PLATE I. A hillside covered with mitsumata, the Japanese paper plant. Frontispiece.

II. Fig. 1.—Mitsumata plant two years after transplanting from nursery row. Fig. 2.—Three-year-old shoots from an old mitsumata stump 24

III. Fig. 1.—A bundle of peeled stems of mitsumata. Fig. 2.—Boards covered with drying sheets of mitsumata paper 24

IV. The udo plant in the field 24

V. Fig. 1.—Young root cutting of udo planted in the spring, showing new shoot. Fig. 2.—Old root of udo planted in the spring, on which a young shoot has formed. Fig. 3.—Blanched young shoot of udo more than 2 feet long, taken from the forcing bed in May.. 24

VI. Fig. 1.—Young wasabi plants ready to set out. Fig. 2.—A patch of wasabi on a hillside 24

THREE NEW PLANT INTRODUCTIONS FROM JAPAN.

MITSUMATA, A JAPANESE PAPER PLANT.

INTRODUCTION.

The facts for this paper were collected during a four months' stay in Japan, and represent work accomplished by Mr. Barbour Lathrop's third expedition in search of valuable seeds and plants.

It is hoped that the introduction of this new Japanese paper plant and its ultimate culture in the warmer parts of the United States will be encouraged by this brief account of its cultivation in Japan, for the production of any of the Japanese bark papers, which are for many purposes much superior to our own, will be a material addition to the wealth of the country and give the cultivators of the South a new crop of value.

Japanese napkins, umbrellas, and lanterns have taught the Occidentals new uses of paper, though the lesson has been but half learned.

The papers employed by the common people of Japan are immeasurably more varied than with us. They form one of the important economies in the life of the peasant, and it is such ingenious uses of plant material as this employment of the bark of a shrub that makes it possible for 42,000,000 Japanese to live on the productions of a cultivated area about one-third the size of the State of Illinois.

The walls of the Japanese houses are wooden frames covered with thin paper which keeps out the wind but lets in the light, and when one compares these paper-walled "doll houses" with the gloomy bamboo cabins of the inhabitants of the island of Java, or the small-windowed huts of our forefathers, he realizes that, without glass and in a rainy climate, these ingenious people have solved in a remarkable way the problem of lighting their dwellings and, at least in a measure, of keeping out the cold.

Their oiled papers are another important element in the peasant life of the Japanese, and are astonishingly cheap and durable. As a cover for his load of tea when a rain storm overtakes him, the Japanese farmer spreads over it a tough, pliable cover of oiled paper, which is almost as impervious as tarpaulin and as light as gossamer. He has

doubtless carried this cover for years, neatly packed away somewhere about his cart. The "rikisha" coolies in the large cities wear rain mantles of this oiled paper which cost less than 18 cents and last for a year or more with constant use.

An oiled tissue paper, which is as tough as writing paper, can be had at the stationers for wrapping up delicate articles. Every farm-house has its stock of wrapping paper which has been in use for several years and seems as strong and flexible as ever. It has been tanned with the fermented juice of green persimmons and made into "shibu gami," which is more impervious to moisture than ordinary paper and much tougher.

In the tea factories, the piles of paper sacks filled with tea are made of shibu gami, and 8-year-old sacks covered with paper patches are a common sight. It is said that these tanned sacks keep the tea in better condition than any other sort, and that they last with careful use for many years. Grain and meal sacks are almost always made of this same paper in Japan, for it is not easily penetrated by weevils and other insects.

But perhaps the most remarkable of all the papers which find a common use in the Japanese household are the leather papers of which the tobacco pouches and pipe cases are made. They are almost as tough as French kid, so translucent that one can nearly see through them, and as pliable and soft as calfskin. These tobacco pouches quite change one's notions of the characteristics of paper, for the material of which they are made is as thick as cardboard, but as flexible as kid. Even woven fabrics of which the warp is paper and the woof cotton are manufactured, and these find a place in the Japanese household, while the use of paper napkins and handkerchiefs, umbrellas, and lanterns is as much a part of home life in Japan as the use of cheap tin articles is in America. The country is rich in the possession of these conveniences, any one of which would be an addition to the comfort of a European peasant or an American farmer. But the reason for this remarkable use of paper articles does not lie wholly in the absence of cheap skins, though it is true that few domesticated leather-producing animals exist in Japan. The quality of the papers themselves makes them suitable, as ours are not, to these various purposes.

In strong contrast with those of the Occident, these are bast papers, made from the inner bark of shrubs or small trees, while the papers of Europe and America are either from wood pulp, the macerated stems of wild grasses, or the cotton and linen rags of the ash barrels. It is not a pleasant thought that the brilliant white note paper which your hand rests upon may have in it the fibers from the filthy garment of some Egyptian fellah after it has passed through all the stages of decay until it is saved by a ragpicker from the gutter of an Egyptian town; and yet it is a fact that hundreds of tons of Egyptian rags are

exported every year into America to supply our paper mills. At Mannheim on the Rhine the American importers have their rag-picking houses, where the rags are collected from all over Europe, the disease-infected Levant not excepted, and where women and children, too poor to earn a better living, work day after day, with wet sponges tied over their mouths, sorting these filthy scraps for shipment to New York. Our best papers are made of these rags and our common ones of wood pulp, which is obtained by grinding and macerating huge blocks from some of our soft-wooded forest trees. The bast papers, therefore, are a creation of the Orient and are more nearly related to the South Sea Island tapa than to any of our products.

To the fact that they are made from bark they owe their peculiar character. They are as a rule softer, silkier, tougher, and lighter than our papers. If wet, they lose their strength, like tissue paper, but on drying regain it. They are usually absorbent, and for this reason were considered in the olden days as very valuable in surgery. Whether or not the methods employed in their manufacture are responsible for the yellow tinge which they always have is a question for investigation. As writing papers they are designed for brush work, and as a rule are not suited without treatment for pen work, because the fibers in them are so long that they are continually getting caught in the nibs. This difficulty, however, is obviated by a dressing of alum.

SPECIES OF PAPER PLANTS IN JAPAN.

According to the Japanese writers, there are at least nine plants from which papers are made in Japan, each species furnishing a different variety of product. Two are species of the paper mulberry (*Broussonetia*), one the white mulberry (*Morus alba*), another a species of Daphne (*D. pseudo-mezereum* Gray), three are wild forms of a small tree (*Wickstræmia*), and one, the *Edgeworthia papyrifera*, furnishes the pulp for the mitsumata paper, of which we import large quantities every year, especially for use as legal documents, diplomas, deeds, bonds, etc.

The main object of the writer is to give a description of the mitsumata plant and its culture, with the purpose of interesting Americans in the question of its cultivation and the manufacture of the extremely useful papers which can be produced from its bark and which deserve to be widely known throughout America.

THE MITSUMATA PLANT.

Edgeworthia papyrifera S. & Z. is the botanical name of the mitsumata paper plant, and the systematists place it, along with the Daphne, among a number of forms with lace-like bark, in the order *Thymelæceæ*. It is a pretty, decorative shrub, with characteristically branching

stems, broad, light-green leaves, and delicate yellow flowers which are borne in heads. Its forks are always composed of three branches instead of two, as is common with other shrubs, and this character alone distinguishes it from any common shrub in cultivation. It is sometimes grown in Japan for its decorative yellow flowers alone. The Marquis Matsudaira, formerly one of the feudal lords of the country, has it planted inside his castle walls at Fukui as an ornamental plant. Scarcely over 5 feet high, it has, as a result of its peculiar branching habit, a characteristic vase form. (Pls. I and II, fig. 2.) Owing to the fact that in the cultivation of the plant it is continually pollarded near the surface of the ground, it is difficult to say what the plant would grow into if left to itself. The light, brownish-gray bark is thick and lace-like as a piece of tapa, and one can easily spread a bit of it out with the fingers into a web-like, rough fabric. The small fruits are borne in clusters and are about a quarter of an inch long. Each fruit contains, inside the thin layer of flesh, a shiny black, sharp-pointed seed, with a thin shell and milk-white contents.

In the provinces of Shizuoka, Nogano, and Fattori are quite extensive plantations of mitsumata, and it is said that the areas under cultivation are steadily increasing. As a rule, the plantations occupy land which is not fit for rice growing, such as hillsides too steep for terracing and valleys too narrow to make rice culture practicable.

Red or yellow clay of volcanic origin, mixed often with rocks and coarse gravel, seems to suit the plant admirably. The hillside plantations sometimes reach to the line of newly cut cryptomeria forest, and even cover the tops of the hills from which, many years before, the timber had all been cut. Good drainage seems to be one necessary requisite to the growth of the plant in the wet climate of Japan, but its culture between the rice fields proves that it can stand heavy irrigation, though a plant not well suited to withstand drought.

THE CULTIVATION OF MITSUMATA.

Early in June, in Japan, children not over 8 or 9 years old are sent through the plantations with baskets to pick the ripe fruits of the mitsumata. The plants produce seed sparingly, it is said, so that the work of collection is much like picking wild blackberries or strawberries in America, but it is far more irksome for the children, for instead of being palatable the thin-shelled seeds contain an exceedingly acrid endosperm.

The seeds, with their thin, green flesh, are spread out to weather until the latter has rotted away, leaving the black seeds, which are packed in a sack made from the double sheath of the native palm. The meshes of this natural sack are fine enough to prevent the seeds from falling out and still allow the air and moisture to enter. In this form they are buried in a hole in the ground under the shelter of an

overhanging roof or are stored in some outbuilding and kept until planting time the following February. The price of this seed varies greatly; from 30 cents to $1.50 a gallon was the range quoted the writer by the peasants.

In the middle or toward the last of February the seed bed is prepared and the seeds are planted in rows a foot or so apart, where they are given the usual care of weeding and cultivation which all seedlings require, and where they remain for one year, or until 8 or 9 inches high. These young plants are then set out on the hillsides, after the ground has been prepared for their reception by working it over with a mattock or fork. They are put in at the rate of 20,000 to 24,000 to the acre, or about a foot and a half apart each way. On the hillside plantations shelter trees of a species of alder (*Alnus maritima* var. *japonica*) are planted 20 to 30 feet apart. The roots of these trees are said to help bind the loose soil, the dead leaves form a mulch, and the branches form a wind-break, preventing the winds from whipping the young shoots of the mitsumata plants. Two or three cultivations a year are given to keep down the weeds and loosen the soil, and by the end of the first year after transplanting the harvest of bark is ready.

The harvesting is done any time in the winter and consists merely in cutting the plants down to the ground by means of a heavy knife, binding them into bundles, and transporting them to the farmhouse. Though the tops are cut down every other winter, the roots of the mitsumata plants remain alive for many years—roots a hundred years old are known, it is said—but for commercial purposes the stumps of the plant cease to produce profitable crops of new shoots after ten or twelve years, when they are dug out and young plants are set in their places. It requires two years for an old stump to produce a marketable bush, and many of the plants are evidently allowed three or four years to grow before being cut down again.

The crop would naturally be a biennial instead of an annual one, but owing to the fact that some plants have to be replaced earlier than others a field of mitsumata soon has growing on it plants in various stages of maturity, and the cutting can be done every winter.

From 600 to 2,000 pounds of raw bark per acre are produced by this plant, according to a statement made by a paper manufacturer, and when made into pulp it is worth in Japan 15 to 16 cents gold per pound, or four times what the imported wood pulp from America sells for in Yokohama.

The bark is removed from the cut shoots by the peasants, who soak them in hot water and strip off the bark by hand. From the clean appearance of the bundles of peeled branches it seems probable that the bark slips off easily (see Pl. III, fig. 1), leaving light, porous faggots, suitable for kindling wood. Whether or not the bark could be removed by machinery has yet to be investigated, but the soft

nature of the wood makes it seem an easy matter to crush the stems and separate the wood from the bark after the crushing. The fact that in Japan these, as well as the other processes, are done by hand signifies little as regards the possibility of the application of machinery, when it is remembered that until two years ago such simple operations as tea firing and sifting were done there—and are yet to a large extent—by hand.

THE MANUFACTURE OF MITSUMATA PAPER.

Small paper factories are scattered along the banks of the picturesque mountain streams in central Japan, and the broad drying boards covered with sheets of fresh paper are common sights in many of the mountain villages. (See Pl. III, fig. 2.)

The freshly stripped bark is macerated in vats of warm water and the thin outer bark is removed by scraping with a dull knife. The purity of the paper depends in large measure upon how thoroughly this dark part is removed, for any small particles that are overlooked in the cleaning make dark flecks in the paper. After cleaning, these soft, spongy strings of bark are thrown into a vat filled with caustic soda, and are left to macerate thoroughly until the fibers can be easily separated from each other. The macerated bark is then pounded, either in a stone mortar with a heavy wooden mallet or by means of a stamping mill run by water power until it is a homogeneous pulp. It is then mixed with water, bleached with chlorid of lime, and put into a large vat, from which small quantities are taken by the hand screens which the operator uses in making the sheets of paper. A mucilage made by macerating the root of a species of hibiscus (*H. manihot*) is added in small quantities to the pulp to make the fibers stick together. The amount of this mucilage used seems to be a matter of experience. One woman can make, by means of her bamboo hand sieve, 600 sheets of paper a day, and, according to the prices given me through an interpreter, this medium quality of paper sells for about 94 cents a hundred sheets. It is very interesting to watch how skillfully the operator lifts from the vat a screen half full of thin pulp, poises it and shakes it for a second or two, allows the water to drain out for a few moments, then quickly lifts the screen and, inverting it, lays it face down on the pile of previously made sheets. She then gently and slowly lifts the sieve and leaves a thin layer of wet pulp upon the continually thickening pile. With a hand press the water is squeezed out of this pile of wet papers, the individual sheets are stripped off one by one, brushed out on smooth boards with brushes just like those used by the paper hanger to spread the paste on wall paper, and are then put out in the sun to dry, after which simple process the papers are packed in bundles and taken by pony or bull pack animals to the nearest market. In at least one town in Japan paper-

making machinery is being employed in the manufacture of the finer grades of mitsumata paper for export to America. These machines are rotary, steam-heated drums for macerating the pulp with caustic soda, and the regular pulping tanks for separating the fibers and in which the blanching process is carried on. In the mill which the writer visited the same bamboo hand sieves were employed by the operators in making the sheets from vats of the pulp, so that the papers made by this mill should still be classed as handmade papers.

The laborers at work in separating the inner from the outer bark were getting only 9 to 10 cents gold a day, and it seemed as if the work was so mechanical in nature that it could easily be done by machines; but this question could only be decided by an investigation made by experts in such matters. The question also whether the hand sieves could be done away with and continuous-process machines substituted for them must be settled by repeated trials. Problems which appear much more complicated have been solved by American mechanics.

THE MANUFACTURE OF LEATHER PAPER.

"Tsuboya" paper is a most peculiar looking substance. It resembles oilcloth, but has a texture more nearly resembling that of fine leather, except that it is more or less translucent, like oiled pigskin. In the province of Ise, Japan, are noted manufacturers of tobacco pouches who use only this leather paper in their manufacture, and the variety of styles in which they make their papers is remarkable.

Yamada, where Seibei Ikebe (who is probably the most noted maker) has his shop, is a favorite place for pilgrims, and for several generations Ikebe and others have sold them their paper tobacco pouches until it has become the fashion for every pilgrim to bring back from his pilgrimage to Yamada a paper pouch as a souvenir.

Some of these leather papers are smooth and almost transparent; others are rough and stamped with pretty patterns, a host of different colors being used in their printing. They are in character a kind of wrinkled oiled cardboard and the process of their manufacture is a tedious though comparatively simple one.

A thick, weak cardboard called "onagashi" paper, which is manufactured of bark fiber in one of the interior towns near Gifu, is imported into Yamada in large quantities. Before processing it is soft and tough, but will break like any thin cardboard. To transform it the sheets are moistened and then wrapped about a small round stick the size of a broom handle. Several sheets are wrapped at a time, separated from each other by special dry papers which have been painted with persimmon juice to tan them, and the roll of these papers is finally wrapped with a cloth and tied. This roll, out of both ends of which the stick protrudes, is put under a long lever, one end of the

stick being stuck through a hole in the lever and the other lodged in a hole through the floor. The workman then sits on the long end of the lever and teeters until the roll of papers, which was originally about 18 inches long, is reduced to not more than 12 inches. He then removes the roll, undoes it, spreads out the papers, again arranges his dry sheets, and prepares another roll for the lever, inserting the same papers in a different position. Eight times he subjects the papers to this wrinkling process, and each time they become smaller, thicker, and more pliable until, after the last wrinkling, the cardboard is as soft and limp as a bit of muslin.

Once through the wrinkler, the paper is given a coating of oil made from the seed of a labiate (*Perilla ocymoides*) and hung out to dry. For over a hundred days it is hung in the open air to allow the oil to harden, and even two hundred days are sometimes required to finish this part of the process. After being once dried out the piece of wrinkled oil paper can be treated in almost any way—shaved or scraped with a sharp knife, stamped or beaten with dies or patterns, or given a coat of lacquer varnish. If colored papers are required, the pigments are applied before the oiling process.

Although these remarkable papers are used now almost exclusively for tobacco and other pouches, there are other uses to which the inventive American mind can put them, such as book covers, portfolios, table covers, etc., and the writer is of opinion that, should they once be available to the common people, many new and important applications for them would be found.

A similar form of these leather papers is the Japanese handmade wall paper, which is already becoming fashionable in America. Large factories are running near Tokyo which turn out the most beautiful designs for wall and ceiling decoration. These wall papers are wrinkled in the way previously described, though evidently not so finely, and are then stamped and modeled by hand into the most artistic designs imaginable.

The extent of the leather-paper industry is not great, but, as it is, over 200,000 paper pouches are made annually by one firm alone in Yamada and about $15,000 worth of business yearly is claimed to be done by the same firm.

Any plant from which can be produced a set of papers widely different from those we already have is worthy of consideration by the cultivators of the country, and if the processes of manufacture can make out of it better, stronger envelopes, finer and lighter wrapping paper, more suitable toilet papers, or a cheap and useful substitute for leather, the cultivation of the plant in America may prove decidedly profitable.

As the species of mitsumata is not one which will withstand much cold, it is useless to try to grow it in any regions where the

thermometer sinks below 10° F., and as it requires moisture there would be no reason for testing it on the dry plains. The irrigated rice fields of Texas, with their unoccupied dikes and narrow strips of land between the fields, would form excellent trial places for the plant, and the Colorado Desert, with its rich soil and abundant water supply, might prove well adapted to its cultivation. The moister portions of Florida and Louisiana could be used for experimental cultivation, and the irrigated regions of the Sacramento and San Joaquin rivers would probably be suitable for the growth of this Japanese paper plant.

UDO, A NEW WINTER SALAD.

INTRODUCTION.

Nothing has yet been found which competes with lettuce for the first place as a winter salad, but for a change there are so few salad plants which can be had in the winter that a new and eligible one is surely worthy the serious attention of the public.

Udo is a plant which has been in cultivation for many years in Japan, and was probably introduced from China, where it is known as a vegetable under the name of t'u-tang-kuei, according to Dr. Augustine Henry in his notes on the Economic Botany of China.

In the tea houses all over Japan its crisp, blanched stems are served fresh with salt or boiled with a soy sauce. Eaten as served by the Japanese, it would not be likely to attract the attention even of one in search of such things except as being the best of the collection of those characteristic dishes which form the menu of a Japanese meal.

To Miss Fanny Eldredge, of Yokohama, belongs the credit of having first adapted this udo to the requirements of the Western table, and it was at the home of Mrs. Stuart Eldredge that the attention of Mr. Lathrop was first called to this novelty in winter salads. Even old residents in Japan are unfamiliar with this truly delicious vegetable.

As served in Western style, udo is a mass of thick white shavings, 2 to 3 inches long by a half inch wide, with a brilliant, silky luster. Miss Eldredge has found that the best dressing is a French one of oil, vinegar, salt, and pepper, and her method of preparation is to cut the shoots into long, thin shavings and allow these to stand in ice water for several hours before putting them into the salad bowl and pouring over them the French dressing prepared in the usual way.[a]

These slices of udo are crisper than slices of celery and have none of the objectionable stringy fibers of the latter. They have a fresh

[a] The recipe for the dressing is as follows: For one salad bowl of udo, take one tablespoonful of vinegar, one teaspoonful of salt, a liberal sprinkling of black pepper, with a drop or two of tabasco sauce; stir thoroughly until the salt is dissolved and then add five tablespoonfuls of olive oil.

taste, like the midrib of a lettuce leaf, with a slight but most agreeable suggestion of pine flavor. The tenderest young shoots of celery could not be more brittle than these blanched stems of udo.

From the 1st of October until the middle of May this vegetable is for sale in the markets of Japan, and in this winter character, aside from its being an excellent salad, lies its great value. It is comparatively cheap and is eaten by the poor Japanese as well as by the rich.

From its adaptability to winter culture and its excellent quality, this plant deserves to become as well known as asparagus or celery.

Botanically the plant is known as *Aralia cordata* Thunb. It has been recognized as an ornamental plant in Europe and America, where its large, sharply lobed, regular leaves have been highly prized for their decorative effects. (See Pl. IV.) The edible portions of the plant are its young shoots, which are blanched by being covered with earth.

There are two varieties of udo, called respectively "kan udo" and "moyashi udo," and these, though of similar appearance as they are placed on the market, are quite differently cultivated.

Through the assistance of Mr. H. Suzuki, of the Yokohama Nursery Company, I was able to learn from the growers of this vegetable how it should be cultivated. Its cultivation is not difficult and will be easily understood by anyone acquainted with the ordinary methods of forcing asparagus.

THE CULTIVATION OF KAN UDO.

The seeds of this variety are sown broadcast in seed beds, prepared of rich garden earth, in the month of March or April, and are allowed to grow there for one year. The following spring the individual seedlings are transplanted from this seed bed, after the tops, which have died during the winter, have been removed, and they are then set in rows 2 feet apart and 10 inches from each other in the rows. In these rows they are cultivated all summer, or until September, when the leaves begin to turn brown. The stems are then cut back close to the rootstocks and the earth is piled up in a mound 2 feet high above the latter. In forty days the new shoots, which begin to form as soon as the old ones have been cut back, appear above the surface of the mound. They are then ready for cutting, and the mound is opened and the marketable shoots cut. Each rootstock produces about five of these blanched shoots, three of which are probably fit for the market at the first cutting, early in October. The remaining small shoots are covered up again and allowed to grow for a second cutting a week or so later. In removing these shoots for market care is taken to cut close to their bases, so as not to leave stubs, as the presence of the latter is said to prevent the rapid growth of the remaining young shoots.

Generally only two crops of shoots are secured of the kan udo, but

occasionally there are three. After the removal of the last crop the rootstocks are buried and allowed to remain over winter. In the spring the mounds are opened and rich manure is applied in trenches running on both sides of the plants. Throughout the summer the plants are allowed to grow and are again cut down in autumn and treated in a similar way to that just described. The life of the kan udo rootstock is more than ten years, but beyond that age its use ceases to be profitable.

Although generally grown from seed, this variety can be reproduced from root cuttings, though the latter method is considered less practicable, owing to the fact that the large root cuttings take up more space in the field.

The season for kan udo is October and November, and being the earliest variety and occupying the fields to the exclusion of other crops it is also the dearest, sometimes selling for as much as 25 cents for a bundle of 16 shoots. It is not otherwise preferable in any way to the other variety, which first appears in the market toward the end of November.

THE CULTIVATION OF MOYASHI UDO.

The moyashi or forcing udo is grown from root cuttings, which are purchased by the growers from special cultivators who have their seed beds on the slopes of Fujiyama. These young sets, which have been grown from seed the year before, are dug in November and kept all winter packed in straw. They are bought in early spring by the cultivators and kept ready for planting, which is done during March and April.

The root cuttings are laid lengthwise in a shallow trench about 4 inches apart, and in the space between them a small quantity of rich manure is placed. They are then covered with 2 inches of soil. As the leaves appear, the trench is gradually filled about their bases, and, with the usual cultivation to keep down the weeds, the plants are allowed to grow until the end of October, or until frost. These two-year-old plants are then dug, the dead stems are removed, and the plants packed away in a dry place until wanted for the forcing bed. They may be kept for several months in this dry condition without injury.

The forcing bed is made by digging a trench 3 feet wide and 2 feet deep and putting on the bottom a thin layer of barley husks or a sprinkling of bone dust, over which is spread an inch of rich, light garden soil, mixed with about 10 per cent of leaf mold.

The dry udo sets, which are kept in stock, are packed as closely together as they can stand in the bottom of the trench, which is filled in and heaped up with the same light soil. In about fifty days the first

shoots appear above the mound and are cut, like asparagus, by digging down to the base or by inserting a long knife into the mound.

By preparing a series of forcing trenches and planting them at different times, fresh shoots of the moyashi udo can be had all winter long, from November until the beginning of May.

At the close of the forcing season the rootstocks are taken from the trench, planted out in rows, manured heavily, allowed to grow all summer, and forced again the following winter. These same roots are used for several years. (See Pl. V, figs. 1, 2, and 3.)

Although cheaper than the kan udo, this forcing variety will probably be better suited to our American conditions, for it yields shoots throughout the winter, while the other sort produces them only in October and November. The mild winters in Japan make these forcing beds in the open ground possible, and it is probable that as far north as Norfolk, Va., the culture of udo in a similar way could be carried on; if not, certainly Florida and California truck growers could cultivate the plant. The kan udo might be grown even farther north where the ground does not freeze until after the last of November.

WASABI, THE HORSE-RADISH OF THE JAPANESE.

INTRODUCTION.

There is a fresh sharpness about Japanese wasabi that not even the finest Austrian sorts of horse-radish possess. The color, too, is not generally white, but a delicate shade of green, and although served much in the same way that horse-radish is served in America, it is quite a different thing.

The roots, which are grated up to prepare this Japanese appetizer, are produced by a plant of the same family as the true horse-radish and the mustard, and botanists give it the name of *Eutrema wasabi*. (Pl. VI., figs. 1 and 2.)

To anyone fond of such things this Japanese horse-radish will prove an acceptable novelty, and it is with the object of acclimatizing wasabi in America that a few young plants have been secured and will be propagated and tested in the trial gardens of the Department of Agriculture.

In Japan grated wasabi is a constant accompaniment to the raw fish which forms such a prominent part of a Japanese meal. Without it the fish would taste as unnatural to a diner as blue-point oysters on the half-shell without horse-radish would taste to the average American. Wasabi is, in fact, universally used in the inns and tea houses of the country.

The wasabi plant is a peculiar one to cultivate, and there are certain localities in Japan where it is grown, notably in the region about Hiroshima. It is popularly believed that the culture must be carried

on in running water, but this is not absolutely correct, for near Nara, in the little village of Kiriyama, there are patches of wasabi which have been grown for many generations by the same family in a location not flooded with water.

With Mr. K. Yendo of the Tokyo Botanic Gardens as interpreter, the writer visited, in June, 1902, one of the cultivators of wasabi and gleaned from him a number of facts about the culture of the vegetable. Mr. Kawakita, whose father and grandfather before him had grown wasabi, carried on its cultivation as the growers of Fourche Maline do the horse-radish—only as a secondary crop. His patches of the plant were in a narrow valley, shaded by persimmon trees, where the soil was wet by underground springs, just such a place as one would expect to find ferns in were the ground not cultivated. (See Pl. VI, fig. 2.)

Owing to the ravages of a small caterpillar which had riddled the leaves with holes, the plants presented a sorry enough appearance, and the owner took no pride in showing them. The general appearance of the slopes of the little valley was as if they had been covered with a coarse, broad-leaved dock like the *Petasites*, which is common in parks in Europe.

THE CULTIVATION OF WASABI.

The method of culture practiced by Mr. Kawakita is a simple one enough, the chief point being the selection of a suitable location for the patch. Moisture is essential, and the borders of a mountain brook or a bit of "springy" meadow in the hills would form a suitable situation. Shade is likewise looked upon by this gardener as necessary, and that cast by the kaki or Japanese persimmon trees is preferred. The soil is a stiff clay, mixed with gravel, which retains moisture for a long time.

In the month of June, when the 2-year-old plants which are ready for market are dug, the young suckers are carefully removed from the marketable roots and are planted out in the field. They are set in rows that are 1½ feet apart and are put only 10 inches from each other in the rows. Weeding is done as found necessary, and in February or March the plants are hilled up to make them produce longer and larger roots for the market.

Liquid manure and rape-seed cake are two of the principal fertilizers of the country, and these are applied judiciously in November and March in quantities varying according to the soil conditions.

For two years the young wasabi plants are cared for in the field, at the end of which time their roots are large enough to be dug. Over 2 tons of these roots are said to be harvested from an acre.

The roots are prepared for market by washing off the dirt, cutting back the tops, and binding into bundles. They keep for some time,

just as horse-radish does. There is said to be a difference between the wasabi which is grown directly in the running water and that cultivated in wet locations in the mountains, the former having a greener color. Roots that are grown in the mountains have a finer flavor than those which are cultivated on the plains, it is said.

The roots are generally grated and served as horse-radish is served in America, but they are sometimes pickled with sake vinegar, the residue from the rice wine of the country, or are used to give a snap to certain kinds of confectionery. The fresh leaves are also employed in the manufacture of a pepper sauce by putting them in a bottle, pouring hot water over them, and allowing them to stand for several hours.

A vegetable which has become to the Japanese what horse-radish is to the Occidentals can hardly fail to attract the attention of those Americans who are seeking new and appetizing relishes.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. *Frontispiece.* A hillside covered with mitsumata paper plants, near Shizuoka, Japan.

PLATE II. Fig. 1.—Mitsumata plant two years after transplanting from nursery row. Fig. 2.—Three-year-old shoots rising from an old mitsumata stump, near Shizuoka.

PLATE III. Fig. 1.—A bundle of stems of mitsumata after the paper-producing bark has been removed. Fig. 2.—Boards covered with drying sheets of mitsumata paper.

PLATE IV. Plants of the kan or summer udo growing in the field. From a photograph taken on the experiment station grounds of Marquis Matsudaira at Fukui, Japan, by Yendo.

PLATE V. Fig. 1.—Young root cutting of the forcing udo after it has been planted for a week or two in the spring, showing the way the new shoot springs from the horizontally laid cutting. Farsari, photographer, Yokohama. Fig. 2.—Old root of the forcing udo after it has been long enough in the soil in spring to start well into growth. Farsari, photographer, Yokohama. Fig. 3.—Blanched young shoot of forcing udo, more than 2 feet in length, as taken from the forcing bed in May. The white portion only is edible, the dark part being the old root, which produces, one after the other, several such edible shoots. Farsari, photographer, Yokohama.

PLATE VI. Fig. 1.—Young wasabi plants ready to set out. The marketable roots look much like these. Fig. 2.—A patch of wasabi growing on a shady hillside.

FIG. 1.—MITSUMATA PLANT TWO YEARS AFTER TRANSPLANTING FROM NURSERY ROW.

FIG. 2.—THREE-YEAR-OLD SHOOTS FROM AN OLD MITSUMATA STUMP.

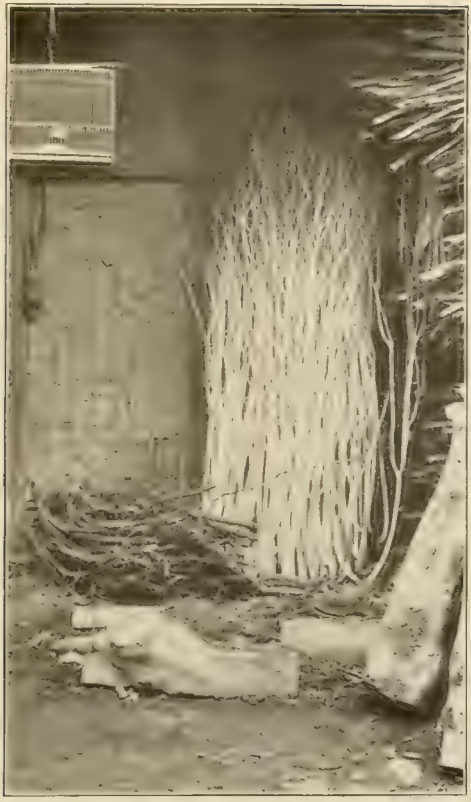

FIG. 1.—A BUNDLE OF PEELED STEMS OF MITSUMATA.

FIG. 2.—BOARDS COVERED WITH DRYING SHEETS OF MITSUMATA PAPER.

THE UDO PLANT IN THE FIELD.

FIG. 1.—YOUNG ROOT CUTTING OF UDO PLANTED IN THE SPRING, SHOWING NEW SHOOT.

FIG. 2.—OLD ROOT OF UDO PLANTED IN THE SPRING, ON WHICH A YOUNG SHOOT HAS FORMED.

FIG. 3.—BLANCHED YOUNG SHOOT OF UDO MORE THAN TWO FEET LONG, TAKEN FROM THE FORCING BED IN MAY.

FIG. 1.—YOUNG WASABI PLANTS READY TO SET OUT.

FIG. 2.—A PATCH OF WASABI ON A SHADY HILLSIDE.

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